

One day at The Sands: Exploring Las Vegas' intangible heritage through virtual reality

*Original*

One day at The Sands: Exploring Las Vegas' intangible heritage through virtual reality / Martina, Andrea; Bottino, ANDREA GIUSEPPE; Rubino, Irene; D., Cook. - In: INTERNATIONAL JOURNAL OF HERITAGE IN THE DIGITAL ERA. - ISSN 2047-4970. - STAMPA. - 4:1(2015), pp. 1-12. [10.1260/2047-4970.4.1.1]

*Availability:*

This version is available at: 11583/2601781 since:

*Publisher:*

Multi-Science Publishing Company

*Published*

DOI:10.1260/2047-4970.4.1.1

*Terms of use:*

openAccess

This article is made available under terms and conditions as specified in the corresponding bibliographic description in the repository

*Publisher copyright*

default\_article\_editorial [DA NON USARE]

-

(Article begins on next page)

# One Day at The Sands: Exploring Las Vegas' Intangible Heritage Through Virtual Reality

Andrea Martina\*, Andrea Bottino, Irene Rubino  
and Daniel Cook

Department of Control and Computer Engineering,  
Polytechnic of Torino

C.so Duca degli Abruzzi 24, 10129 Torino, Italy

Tel: +39 011 090 7175

E-mails: andrea.martina@polito.it, andrea.bottino@polito.it,  
irene.rubino@polito.it, dpcook@mcn.org

[Received date; Accepted date] – to be inserted later

# One Day at The Sands: Exploring Las Vegas' Intangible Heritage Through Virtual Reality

Andrea Martina, Andrea Bottino, Irene Rubino  
and Daniel Cook

## **Abstract:**

The construction, negotiation and dissemination of cultural heritage in the digital era can take advantage of several approaches, including Virtual Reality (VR). Leveraging on the provision of contextualized multimedia content, VR can foster awareness about the histories of specific times and places, encouraging personal interpretative processes. This paper presents the design, implementation and evaluation of "One Day at the Sands", a VR application aimed at conveying the atmosphere of one of the most famous casinos in Las Vegas from the 1950s onwards. First, we collected a digital database, including a wide range of historical material; then, we developed a presentation medium that allows viewers to navigate the virtual reconstructions and access the archival material following their curiosity and interests. User tests underlined the capability of the application to facilitate a deep and meaningful exploration of the contents reinforcing the argument that virtual reality solutions represent valuable tools to engender awareness and explorative attitudes towards heritage.

## 1. INTRODUCTION

The use of digital technologies to build, interpret and communicate narratives about the past has been widely experimented in recent years. In this scenario, the adoption of Virtual Reality (VR) has been shown to provide a stimulating method to communicate heritage and cultural content ([1],[2]). VR approaches combine accurate 3D reconstructions with the provision of interactive environments, thus fostering users' immersion and emotional engagement. Such approaches can be particularly significant when the aim of the interpretative process is to recreate a specific context ([3]). Through virtual environments, the documentary resources used to build that context acquire a new and full meaning from their reciprocal relationships. Furthermore, the possibility to experience simultaneously different pieces of information (3D models, images, sounds and other multimedia contents) is an effective way to convey factual information suggesting at the same time a certain atmosphere, thus providing a setting that may facilitate users' emotional engagement.

Virtual Reality has been extensively used in the archaeological field, but its potential can be applied to modern and even contemporary contexts as well, taking advantage of documentary resources not available for other historical periods, such as records and living memories of people who directly experienced the object of the reconstruction.

In this work, we aimed at exploiting the communicative potential of VR to present a perspective on the history of Las Vegas in the 1960s. The city of Las Vegas (Nevada, U.S.A.) was founded at the beginning of the twentieth century as a railway junction, but started its growth in the 1940s with the construction of the Flamingo, the first casino of the city. Since then, the legalization of gambling in Nevada, the construction of new luxury casinos and the presence of the best artists in the world have been the key factors helping the town to become one of the main entertainment destinations of the United States of America, attracting thousands of people from all over the country and beyond.

At present, Las Vegas is generally regarded and remembered as the most spectacular and extravagant city for entertainment, while its history is generally not considered, being hidden by the lights and glitter of the modern town. This history, although brief, is nevertheless remarkable, with a variety of social and cultural aspects that arose from that place and expanded into the rest of the country. We thus deemed important to describe in detail and with scientific rigour the history and the events of such a controversial city, in order to increase people's historical awareness about the place.

In particular, the project 'One day at the Sands' aims to rekindle the magical atmosphere of the Sands Hotel, one of the most

prestigious and oldest resort casinos in Las Vegas, which well represents both the city development over the years and the social transformations occurred in the past. The Sands Hotel was 'the place to be' in Vegas from 1952 to its implosion in 1996. It was the seventh resort style casino to open on the Las Vegas Boulevard ('The Strip') on December 15, 1952. Currently, the much-celebrated Venetian resort is located on the former site of the Sands. It was one of the most famous entertainment hot spots through most of its years of existence. The showroom at the Sands, named 'The Copa Room' after the legendary Copacabana Nightclub located in New York City, was graced by some of the greatest names in show business including Judy Garland, Bobby Darin, Luis Armstrong, Nat King Cole, Tallulah Bankhead, Vic Damone, Louis Prima and Marlene Dietrich. Perhaps the Sands' greatest claim to fame occurred during the filming of the original 'Ocean's Eleven' in 1960, when Frank Sinatra, Dean Martin, Sammy Davis Jr., Joey Bishop and Peter Lawford performed together in what was called the 'Summit at the Sands'. The history of the Sands deserves particular attention not only for the popularity of the hotel, but also for the actions taken on a variety of social issues. For instance, the resort received public admiration and approval by declaring its dislike and opposition to nude exhibitions on stage. This was the trend among the casinos and resorts on the Strip, where nudity became an easy way of achieving success and appeal ([4]). The Sands impresario Jack Entratter moved away from this, following his belief that 'the spread of nude shows along the strip [...] could destroy six years of work, expensive campaigns and sincere efforts to make Las Vegas the top entertainment resort in the world'. The costumes of the Copa Girls, the Sands' showgirls, though eye-catching, were never showing nudity, leaving the success of the Sands' shows only to their exceptional quality. The Sands was also the first casino that broke the rigid race segregation on the Strip. James Gay was the first black hotel executive, serving as director of communications at the Sands from its opening in 1952; additionally, after the mid-fifties, Afro-American customers and artists performing on stage were allowed to reside in the hotel.

## **2. Developing a Virtual Reality application to promote the heritage of Las Vegas: the rationale of our approach**

Archives focusing on 20th century include a wide variety of materials, related to both tangible and intangible heritage, such as pictures, documents and letters, advertising billboards, restaurant menus, video footage and radio shows. Since many of these data types are not amenable to museum display in the traditional sense, there is the risk

that a huge amount of recent cultural heritage could potentially be hidden away, or forgotten forever, unless archival institutions find a way of making such material accessible to the public.

Recent advances in digital technologies provided archivists and exhibit designers with new, interesting, and captivating ways of presenting and disseminating cultural objects, thereby meeting the needs of personalization and interactivity required by visitors ([5],[6],[7],[8]). In particular, VR allows the creation of novel exhibition paradigms, rich in the informative and emotional content often missing in classic ones. For example, VR can be used to create displays for objects and architectural elements for which there are records, but where the actual object has been destroyed or lost at some point in time ([1],[9]). Furthermore, virtual restoration of lost sites and buildings is a powerful way of educating people on cultural aspects of past civilizations ([10],[11]). Finally, it can be observed that a large amount of information about cultural elements is related to their original spatial and historical context, an information which is often undisclosed to the general public. Thus, VR can be used to re-create and explore this context, in order to gain new insights on specific elements or to improve the awareness of relationships between them ([12]). Summarizing, Virtual Heritage both enhances visitors' comprehension of cultural contents, making them more readily understandable, and provides a powerful tool for research and teaching ([13]).

Taking into account these considerations, the main objective of our project is to exploit the expressiveness and interpretative potential of Virtual Heritage to present the available archival material in an engaging and entertaining manner. This will enhance the visitor's knowledge and understanding of the atmosphere, characters, and stories behind the history of Las Vegas, in order to bring new awareness to historical material that hitherto has not been considered as an essential treasure of the past.

To this end, we developed a hypermedial, interactive and multiplatform application that combines the recreational aspects of computer graphics and multimedia with the educational purposes of historical archives. The application is rooted in a navigable Virtual Environment that immerses users in the 3D reconstruction of the Sands. The building blocks of the narrative that guides users through their visit are the collected multimedia historical contents (text, images, video, and audio). This material has been stored in a database and integrated into the virtual environment, where it can be accessed by visitors according to their own interest and curiosity. In this respect, the virtual environment both provides a reconstruction of the original historical and spatial context of the cultural objects and serves as a visual interface with the historical database. Furthermore, in order to make accessible the virtual environment to an audience as wide as

possible, we developed an application that can be executed on different hardware and software platforms and even accessed through the Internet.

We would like to underline that, to the best of our knowledge, only one other multimedia project approaching the history of Las Vegas has been presented so far. The Las Vegas Sun newspaper<sup>1</sup> offers, through its website, a multimedia application that allows the user to discover the history of the city. The visitors can explore an interactive map of the Strip through space and time, accessing a large archive of articles and photos related to historical events, relevant places and important characters that marked the period between 1930 and 2007. In our work we have taken a step further, integrating the visual exploration of the historical archives with a virtual reconstruction of the cultural sites and of their original atmosphere, in which users can immerse themselves to gain a greater appreciation of Las Vegas' history.

Another objective of our work is to provide an effective learning environment. While the exploration of the virtual environment and of the related contents can be a learning activity in itself, since the user is exposed to a variety of information, other elements should be taken into account to achieve the planned pedagogical goals at their best. The effectiveness of a Virtual Reality application is related to the concept of *presence*. It is generally expressed as the perception of '*being there*' ([14]), i.e. the subjective belief of users that they are in a certain place, even if they know that the experience is mediated by the computer ([15]).

The explication of presence has been often related to the number of senses involved by the Virtual Environment and to the quality of the sensorial stimuli ([16],[17],[18]). This is however insufficient since the environment must be able to transfer not only the appearance, but also all the significance and characteristics of the context that makes it a place. The basic concept can be summed up in 'a place is more than just a space' ([19],[20],[21],[22],[23]). This is particularly true in Virtual Heritage scenarios, where the '*cultural presence*' plays the main role. Cultural presence is not just a feeling of 'being there' but of being - not only physically, but also socially, culturally - 'there and then' ([2]). Thus, the main aim in Virtual Heritage is to experience culture as a mental process of acquisition of knowledge through places and time ([20]). To this end, the environment and the context become tools capable of transferring the cultural significance of a historic place ([24]).

---

<sup>1</sup> <http://www.lasvegassun.com/history/>

The attention that users pay to the mediated environment is another aspect that contributes to presence. Attention is related to users' focalization and concentration and to their interests ([25],[26],[27],[15]). The adoption of narratives has been found to be important to improve the involvement and to capture the attention of users ([28],[2]). As a consequence, a storytelling experience can help people making sense of history and culture, following a more immediate and effortless approach.

As we will show in the following, these considerations have been taken into account during the design and implementation of our project.

### **3. MATERIAL AND METHODOLOGIES**

To briefly recall the outline of the proposed approach, its main idea is to develop a Virtual Heritage application that allows to present to the general public one slant on the history of Las Vegas through the historical documents related to the Sands, one of the main cultural and entertainment places of the city in the past. These historical documents are stored in a digital archive, which can be accessed by visitors through a virtual environment. The objectives pursued in the design and implementation of the proposed application are the following:

1. allowing visitors to explore the contents of the cultural archive through the integration of this material into a virtual reconstruction of its original historical and cultural context;
2. to enhance the sense of cultural presence, which can help to achieve the pedagogical aims of the project;
3. to ensure the maximal accessibility and the wider dissemination of the research results.

In the following, we will describe the three main stages that, according to Addison ([5]), characterize the development of any Virtual Heritage application: (i) documentation, which involves the gathering of information about the cultural objects under investigation, (ii) representation, related to the technical aspects of the digitization of heritage objects, and (iii) dissemination, concerned with how this information and knowledge is presented to the users by means of interactive digital media.

#### **3.1 Documentation**

The primary source of documentation for the project was the Special Collections archive of the University of Nevada, Las Vegas (UNLV), established at the end of the 1960s to document the history, culture and events that contributed to the development of the city of Las Vegas. It contains a variety of original documents, including



newspapers, posters, manuscripts, maps, architectural drawings, photographs, video and audio tapes. In particular, the section dedicated to the Sands is the richest of the archive and includes:

- images taken inside and outside the resort;
- photographs and documents related to leading figures in the Sands' history, including artists that performed in the casino, distinguished guests, resort workers and the famous Copa Girls, the Sands' showgirls;
- letters of thanks, appreciation and presentation and documents related to the organization of events;
- original menus, advertising and promotional brochures;
- backstage footage of television series and movies shot at the Sands;

These resources are enriched by two specific sub-collections:

- the 'Martin Stern Collection', dedicated to the projects of the architect who designed and defined a significant portion of the Las Vegas skyline, including more than 200 original drawings of the Sands;
- the Oral History Collection, containing audio or video interviews with people that worked or lived in Las Vegas during that period.

This significant amount of documents, accumulated over more than 40 years, was carefully selected and catalogued in order to establish accurate cross references between sources and to maintain their timeline coherence. Other valuable information was found in books (such as [29],[30]), newspapers and magazines of the period and on the Internet. The inclusion of the records of the Oral History Collections was deemed particularly important for the project: memories and life stories are now recognized as valuable historical resources that can add multiple perspectives to the narrative process ([31]), and they are useful both to create new insights into the past and to interrogate previous histories ([32]).

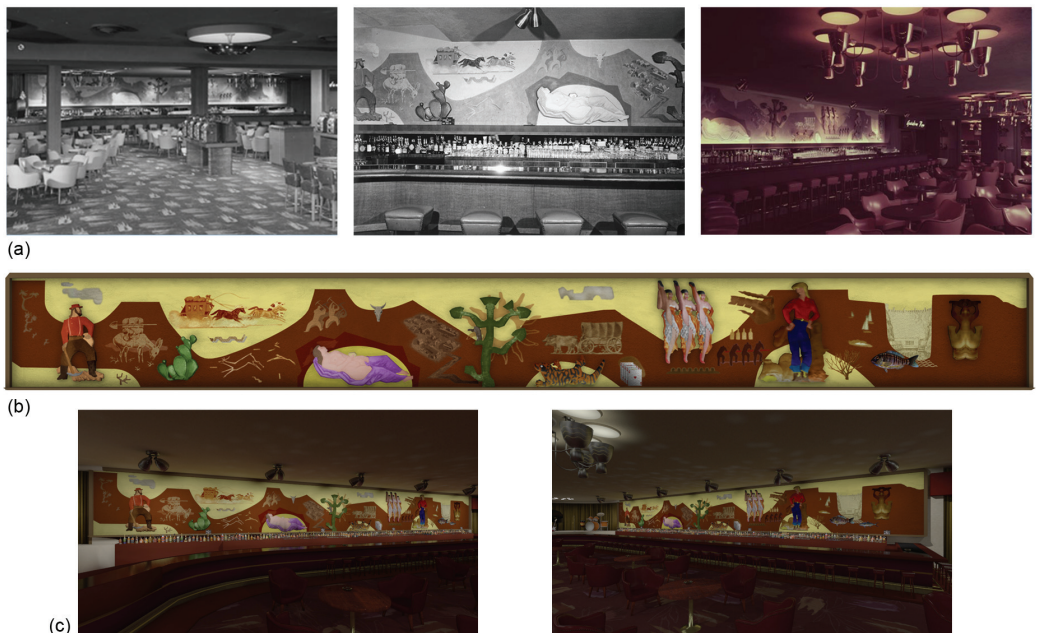
### 3.2 Presentation

The research data were digitized and stored in a database, with accompanying metadata concerning their collection and management. This information was then used as a reference to create the 3D models of the original premises for the Sands' virtual reconstruction, as well as all the objects, furniture, and elements included therein. Since the Sands Hotel underwent several renewals and expansions during its life, we chose 1967 as the reference year since life at the Sands was particularly vibrant at that time, and the documentary resources found for that specific year were particularly abundant.

When their historical images are available, the 3D reconstruction of architectural environments can be based on photogrammetric approaches ([33],[34]). However, such approaches could not be applied in our case, due to the lack of a sufficient number of images depicting the elements to be reconstructed, or those with a suitable quality. Therefore, we divided the process of creating the 3D digital models into the following steps.

First, we defined the main volumes (walls, rooms, streets, gardens, pools, theaters) on the basis of the available project documents, blueprints, plans and sections. Then, we reconstructed furnishing elements and objects included in the real environments using the available iconographic material as reference. Finally, we carried out a detailed work of virtual restoration, i.e. the reconstruction of the original appearance of the artifacts and the choice of the materials and textures to be applied to their 3D models. As an example, Figure 1 shows the mural behind the old Sands bar in the Gambling Room, whose digitally restored version was created by combining different chunks of information, obtained by partial views, often in black and white images, filling in the holes where necessary, and re-coloring the image according to the most convincing interpretation. As we will show in the following, the visitors are able to observe the restoration work in a critical way, since they can directly access in the virtual environment the documents used for these reconstructions.

Figure 1. (a) Images depicting the Gambling Room bar mural, (b) the digitally restored version, and (c) two renderings of the bar.



The Sands main 'spaces' were entirely reconstructed in 3D. These include:

- the exterior, with the famous 36 ft tall Sands sign, the big arches and the pool area;
- the lobby-gambling room with original slot machines, the gambling tables and the bar lounge;
- the Copa Room with the stage where the Sands stars performed every night;
- the suites of the Aqueduct, a three-story building opened in 1963;
- the Emerald conference and ceremony room;
- the office of Jack Entratter, initially Entertainment Director and later President of the Sands, who made the hotel the most famous casino on the entire Strip.

Finally, the lighting design of each space was aimed at reproducing the original atmosphere depicted in the iconographic material through an accurate qualitative comparison between available images and photo-realistic renderings of the environments (Figure 2).



Figure 2. (a) A historical photo of one of the Aqueduct suites, which can be compared with its 3D reconstructed version (b). The accuracy thereof can be appreciated from the superimposition of its wireframe model on the original image (c). Finally, a daytime photo-realistic rendering of the virtual suite is shown in (d).

### 3.3 Dissemination

The presentation layer is a multiplatform hypermedia application where users are free to interact with the virtual reconstructions by choosing their own visiting path. Cultural items, embedded into the

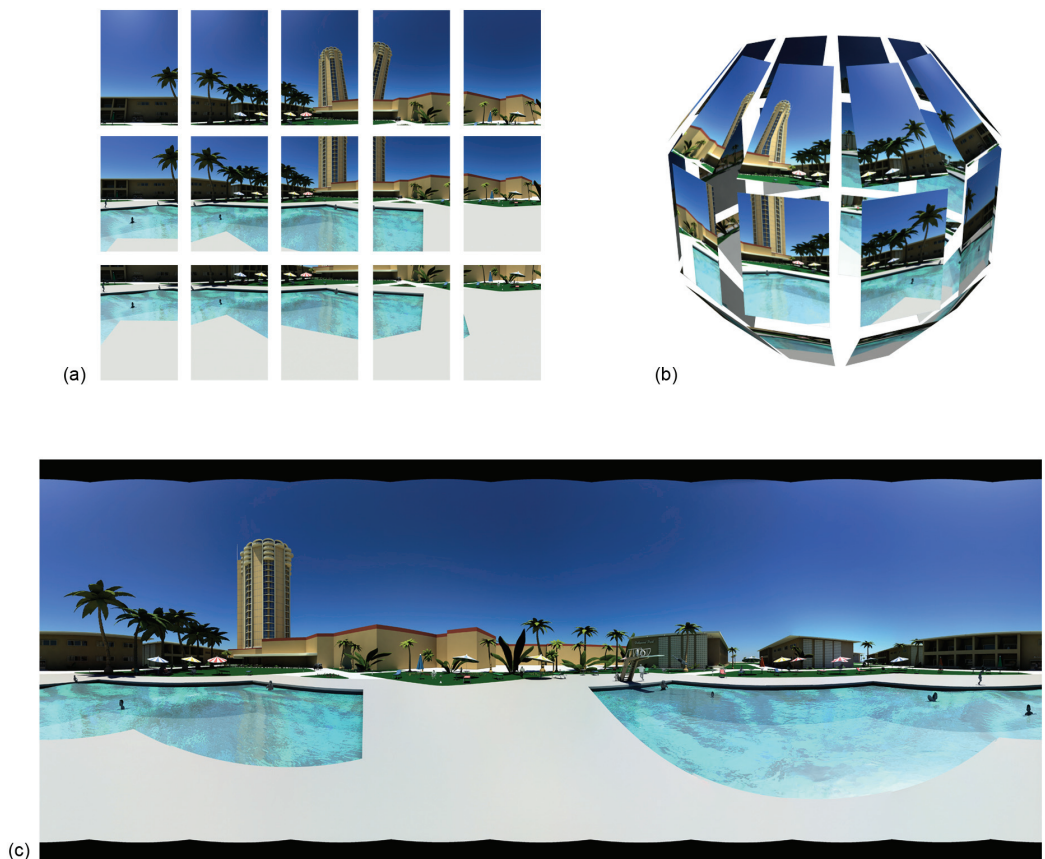
environment, can be accessed by users according to their own curiosity and interests, with the support of a narrative structure that can guide them through the exploration of the virtual spaces.

### 3.3.1 Design of the virtual environment

One of the factors we considered in our work to improve the sense of presence was to maximize the quality of the visual feedback. Approaching photorealistic rendering involves increasing the modeling and lighting complexity, which, in turns, has dramatic effects on the computational resources needed to display the images. Thus, in order to maintain interactive frame-rate, developers must reach an acceptable compromise between the visual realism of the virtual environment and the complexity of its geometric description.

We followed an alternative approach known as Image-Based Virtual Reality (IBVR, [35],[36]). With this technique, the virtual world is represented as a set of initial images, which are used to synthesize the user's view at new and arbitrary viewpoints. In our work, reference images have been obtained from offline photorealistic renderings of

Figure 3. The panoramas are created by taking images with a virtual camera rotated by 360° in 10 steps to create three image strips taken at different elevations (a). The renderings are then projected from their viewpoints onto an imaginary sphere enclosing the viewer's position (b) and stitched together to obtain the final panorama (c).





the virtual environments, computed using high-resolution 3D models and textures, complex shaders, volumetric effects, and advanced rendering techniques. These images are then stitched together, using automatic mosaicing software, to create 360° panoramic images (Figure 3), which are finally displayed on an interactive viewer that allows rotation, tilt and zoom of the surrounding scene. The final high-resolution panoramas (8000 × 4000 pixels) allow to preserve the quality of the images during zoom operations.

To navigate the virtual environment, the user can move between predefined viewing locations, which are linked together to create various paths. In addition, panoramas are enhanced by embedded hotspots that, when selected, allow to access different types of digital media (e.g. commentary, textual documents, photos, audio and video), providing an integrated multimedia experience.

The panoramas of each environment were then populated with images of historical characters, such as performers, employees, and famous and ordinary guests, which were also used as placeholders to indicate the availability of material related to them (Figure 4). Finally, sounds were carefully studied to characterize the different spaces at different times of the day and added into the application to further improve the users' sense of presence.

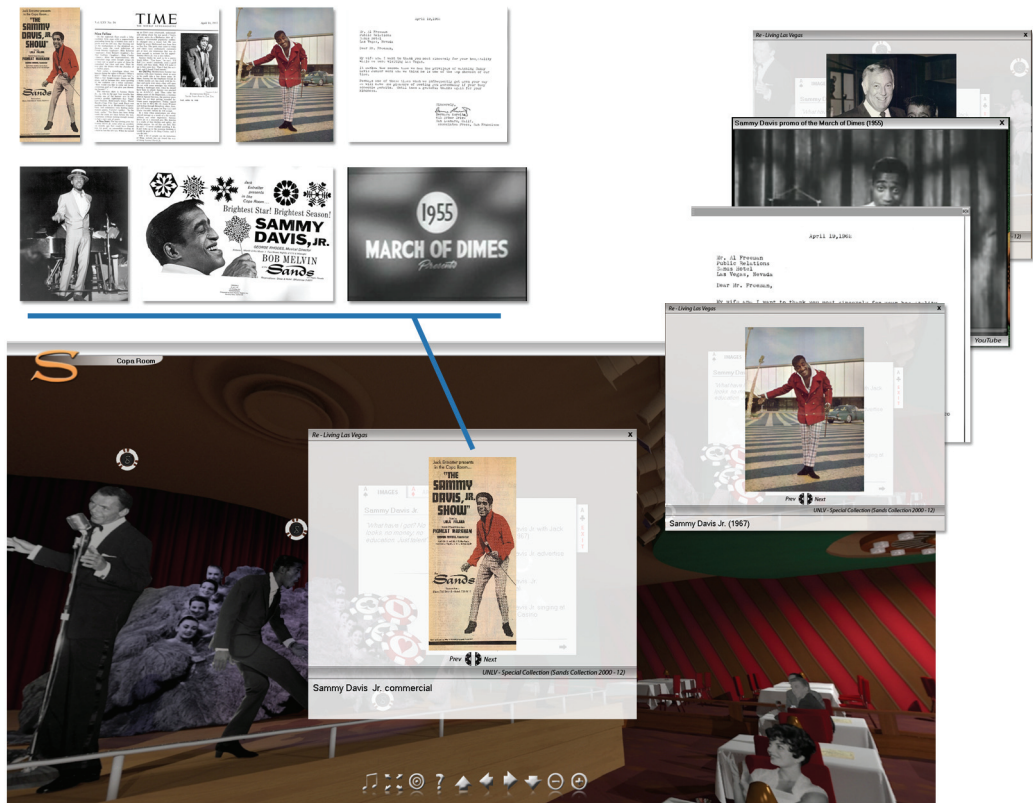
In spite of the limited freedom of movements within the environment, IBVR offers several advantages over the traditional 3D geometric approach:

- high-quality photorealistic views of the environment can be displayed in real-time and manipulated interactively with simple algorithms;
- the requested computational resources and rendering times are independent of the complexity of the virtual environment;
- even with the lack of geometric information, users are provided with a 3D illusion; therefore, the sense of presence in the virtual environment is preserved and even enhanced by a photo-quality realism that resembles that of the real world.

As a further advantage, the viewer for panoramic images is easily portable, being based on a technology (Flash) that is widely supported on different platforms, and it can be embedded into HTML pages, allowing the project to be disseminated through the Internet, thereby reaching a wider audience. As future work, we are planning to port the viewer into HTML5 in order to support iOS devices as well.

As a final remark, we want to emphasize that, in keeping with the advices given by Bottino and Martina ([37]), the entire development process was based on a variety of successful Open Source (OS) software, such as GIMP for image processing, Blender for 3D modeling and Audacity for audio processing. Such products allow a substantial reduction in implementation costs, providing both a variety of features

Figure 4. An example of the archive material, accessible from hotspots in the environment.



commercial software.

and a quality of results that are fully comparable with those of commercial software.

### 3.3.2 Visiting the virtual Sands

Visitors can access and explore the Sands through a guided or a free tour. In the former, the user follows a pre-defined visiting path that takes him/her through a 24 hour journey at the Sands, starting in the morning with his/her arrival at the casino and ending at night with a show in the Copa Room. Conversely, the free tour allows the visitor to access the environments in any order and to create his/her own personal path.

Each of the two alternatives has its own pros and cons. In the guided tour, the user is taken from place to place in the casino, following a storyline that justifies the movement. The tour integrates gaming elements, such as small tasks to complete or items to look for to continue to the next environment. These elements can stimulate the user's participation in the educational experience ([38],[39]). A disadvantage of the guided tour is that the visiting order is

constrained, reducing the users' freedom of choice.

Conversely, the ability to go directly to the place of interest is the very essence of the free tour. Since the concept of 'next environment' does not apply in this case, gaming elements have been omitted. Nevertheless, the edutainment level is maintained, since the user is entertained by the exploration of different places and the search for educational material. The main disadvantage is the possibility that users might miss some places during their tour.

Regardless of the order in which rooms are accessed, visitors are free to move around each environment, navigate the space and interact with it according to their own interests. Narratives in the virtual environment are created by visitors as they choose a certain view of the environment and access the content linked to a specific object.

## 4. EVALUATION AND DISCUSSION

The application has been implemented and ported on the following devices:

- a standard desktop system (monitor, keyboard and mouse)
- a tablet
- a multimedia kiosk, provided with a multi-touch monitor
- a multi-touch interactive table ([40]), which can support collaborative activities and information sharing between multiple users

A preliminary evaluation of the application was conducted with a panel of 21 volunteers, although more extensive test sessions are planned for the future. Our initial tests were aimed at investigating (i) the overall appreciation of the application, (ii) its usability on different platforms and (iii) the effectiveness of the proposed approach and its comparison with alternative ways of presenting the archive material.

The panel of volunteers was composed by male (66.7%) and female (33.3%) subjects, in the 19-45 age range and with different educational and technical competencies. 90% of the users had a previous experience with a Virtual Environment (at least with a First-Person Shooter game). Tests were conducted on the desktop application, the multimedia kiosk and the multi-touch table. The application was not tested on the tablet, since this device basically offers the same interactive experience as the kiosk, only on a smaller screen, and with an higher freedom of mobility offered to the users, which was not a parameter of interest for our evaluation.

The tests were organized as follows. We first asked each volunteer to visit the virtual Sands taking both the free and guided tours on all the above mentioned hardware configurations, in a per-user randomized order. Each volunteer was then asked to fill in a questionnaire, specifying his/her level of agreement with a set of

statements, using a 5-point Likert scale, making choices between options and answering a short oral interview.

The main result was an overall positive appreciation of the application (average score of 3.86). The presented material was not only found to be interesting (3.81), but it also stimulated the curiosity of the users (4.04), inducing them to further explore the virtual environment and focus on the narratives. The volunteers found the application simple to use and the interaction intuitive (3.67). The visual quality of the virtual environment was deemed quite high (4.14), and also the sense of immersion into the reconstruction of the casino was positively rated (3.38), indicating that the contextualized provision of different resources and records was effective in stimulating users' engagement and sense of presence. The guided tour was slightly more appreciated (57.2%) than the free tour, and provided more stimuli to discover the archive material (66.7%), probably thanks to the main narrative that leads visitors through the entire set of environments.

As for the hardware devices, the multi-touch interfaces were preferred to the desktop setup for navigating the environment (76.2%), for accessing archive material (57.2%), and for their usability (85.7%). User preferences were almost equally divided between the two types of multi-touch devices. Since volunteers tested the application individually, we could not explore the options of collaboration and sharing offered by the table, which would have probably improved its rating in a multi-user setting.

Some users' comments were related to improvements in the multi-touch interfaces, such as adding a pinch to zoom gesture for managing images and the possibility of browsing through a gallery, both of which are standard interaction metaphors in smartphones. Another suggestion was to provide a better characterization of the hotspot icons, to give immediate feedback on the type of multimedia content associated with it. These comments were taken into consideration to update the application.

With the aim of investigating the issues of navigability versus quality of visualization, we created a real-time navigable version (RTVR) of two of the Sands' spaces (the gamble and the Copa room) with the same hotspots available in the IBVR. As expected, the IBVR was preferred for its visual quality (76.2%) and the RTVR for its higher freedom of navigation (66.7%). One very interesting result is that, to access the archive content, the IBVR was the favorite interface (80.9%), providing a much better user experience.

We also compared our application with a conventional content gallery based on the same two Sands' spaces, in which users can browse the database by category or search for items using keywords and tags. The IBVR was preferred by 71.5% of the users with some of



the reasons given for this being that 'it offers a greater involvement and raises more interest in the topics covered', 'it allows better interaction with the content in the database', 'it provides greater stimuli to deepen knowledge of the historical period', 'it brings you directly into the environments related to the objects', and 'it provides a useful guide through the contents of the database'. Conversely, the content gallery 'allows a specific object of interest to be found immediately' and 'the use of tags can trigger unexpected connections'.

Concluding, although based on a small volunteer group, the results of the initial tests confirm that the application is viewed positively with respect to most of the metrics evaluated. Particularly, the high levels of immersion experienced by users show that the application was effective in facilitating their engagement, thus creating a stimulating environment for learning.

## 5. CONCLUSION

Virtual Reality technologies are a suitable mean to communicate and make perceivable places and atmospheres no longer visible. One Day at The Sands presents the available archive material related to one of the most famous casinos in Las Vegas during the 1960s, in a captivating and engaging virtual environment that contributes to arise users' interest and curiosity towards the characters and stories displayed. The Sands has been chosen since it represents well both the city development over the years and the social transformations occurred in the past. In our work, we developed an application that allows users to navigate the virtual reconstructions and access the cultural resources in a dynamic way, according to their preferences and interests, thus experiencing a part of the history of Las Vegas in an entertaining manner.

The reconstruction of past environments and the contextualization of the multimedia archived materials, as well as the inclusion of living memories and personal recordings, allow not only to convey factual information, but also to foster emotional engagement and cultural presence.

As future work, we are planning to extend the project, spanning over a longer time period and a wider area of the city. In particular, we have already started working on the virtual reconstruction of different resorts of the Strip and of their changes over time. These elements will be exploited to create interactive, multi-user, mixed-reality environments where original archive materials and enabling technologies can be combined to create a unique edutainment environment. Furthermore, we are planning to build the technical infrastructure to support a 'Virtual Heritage 2.0' approach, where users

can contribute and participate into the development, playing an important role in the expansions of the project.

The positive feedback received from users on both the usability of the system and its capability to encourage interest, curiosity and engagement, which are all triggers for learning and further exploration, suggests that other areas of future research could be represented by the evaluation of the degree of knowledge gained during the digital experience. Additionally, it could be interesting to evaluate to what extent such an application can affect people's perceptions about Las Vegas and influence the will of actually visiting the place. Result of this evaluation could be useful to understand the power of virtual reality tools on current tourism ([41]).

## REFERENCES

- [1] Z. Noh, M.S. Sunar, Z. Pan, *A Review on Augmented Reality for Virtual Heritage System*. 4th International Conference on E-Learning and Games: Learning by Playing. 2009. Game-based Education System Design and Development, Banff, Alberta, Canada, August 09-11.
- [2] E. Champion, *Cultural and Social Presence*. Playing with the Past, Human-Computer Interaction Series, Springer-Verlag London Limited, 2011, 63-82.
- [3] M. Forte, S. Pescarin, *Behaviours, Interactions and Affordance in Virtual Archaeology*. In A. Bentkowska-Kafel et al. (eds), *Paradata and Transparency in Virtual Heritage*, Aldershot, Ashgate, 2012, 189-201.
- [4] "Fuss over too few feathers", *Life Magazine*, New York, August 18, 1958.
- [5] A.C. Addison, *Emerging Trends in Virtual Heritage*. *IEEE MultiMedia*, 2000, 7, 22-25.
- [6] F. Johnson, H. Witche, *The 2010 Horizon Report: Museum Edition*. *Curator: The Museum Journal*, 2011, 54: 37-40.
- [7] H. Sun, K. Chen, C. Tseng, W. Tsai, *Role changing for librarians in the new information technology era*. *New Library World*, 2011, 112, 321-333.
- [8] K. Charitonos, C. Blake, E. Scanlon, A. Jones, *Museum learning via social and mobile technologies: (How) can online interactions enhance the visitor experience?* *British Journal of Educational Technology*, 2012, 43, 802-819.
- [9] J. Jacobson, K. Handron, L. Holden, *Narrative and Content Combine in a Learning Game for Virtual Heritage*. *Computer Applications in Archaeology*, Williamsburg, VA, March 22-26 2009.
- [10] E.F. Anderson, L. McLoughlin, F. Liarokapis, C. Peters, P. Petridis, S. De Freitas, *Developing serious games for cultural heritage: a state-of-the-art review*. *Virtual Reality*, 2010, 14, 255-275.
- [11] M. Ott, F. Pozzi, *Towards a new era for Cultural Heritage Education: Discussing the role of ICT*. *Computers in Human Behavior*, 2011, 27, 1365-1371.
- [12] N. Adabala, N. Datha, J. Joy, C. Kulkarni, A. Manchepalli, A. Sankar, R. Walton, *An interactive multimedia framework for digital heritage narratives*. *Proceedings of ACM Multimedia*, 2010, 1445-1448.
- [13] S. Sylaiou, F. Liarokapis, K. Kotsakis, P. Patias, *Virtual museums, a survey and some issues for consideration*. *Journal of Cultural Heritage*, 2009, 10, 520-528.

- [14] M. Slater, *Measuring presence: a response to the Witmer and Singer presence questionnaire*. Presence: Teleoperators and Virtual Environments, 1999, 8, 560–565.
- [15] M.J. Schuemie, P. Van der Straaten, M. Krijn, C.A. Van der Mast, *Research on presence in Virtual Reality: A survey*. Cyberpsychology and Behavior, 2001, 4, 183–202.
- [16] R.B. Welch, T.T. Blackmon, A. Liu, B. Mellers, L.W. Stark, *The effects of pictorial realism, delay of visual feedback, and observer interactivity on the subjective sense of presence*. Presence, 1996, 5, 263–273.
- [17] M. Roussou, G. Drettakis, A. Chalmers, D. Arnold, F. Niccolucci, *Photorealism and Non-Photorealism in Virtual Heritage Representation*. VAST 2003 and First Eurographics Workshop on Graphics and Cultural Heritage, Brighton, UK, November 5-7 2003.
- [18] M. Roussou, *The components of engagement in virtual heritage environments*. New Heritage: New Media and Cultural Heritage, edited by Y. Kalay, T. Kvan & J. Affleck, Eds. Routledge-Taylor and Francis Group, London and New York, 2008, 225–241.
- [19] S. Harrison, P. Dourish, *Re-Place-ing Space: The Roles of Place and Space in Collaborative Systems*. CSCW '96 Computer Supported Collaborative Work, Boston, USA, November 16-20 1996.
- [20] E. Champion, *Cultural Presence*. Encyclopedia of Virtual Communities and Technologies, edited by Subhasish Dasgupta, George Washington University, Idea Group, Hershey, 2005, 556–561.
- [21] E. Champion, *Evaluating Cultural Learning in Virtual Environments*. PhD diss., University of Melbourne, 2006.
- [22] I. Ghani, A.R.P. Woods, A. Ghani Salleh, *Sense of Place in Virtual Heritage Environment: A Review*. 6th International Conference of the Arab Society for Computer Aided Architectural Design, Manama (Kingdom of Bahrain), February 21-23 2012.
- [23] K. Devine, *Making Place: Designing and Building an Engaging, Interactive and Pedagogical Historical World*. 16th International Conference of Information Visualisation, July 11-13 2012.
- [24] R. Howell, M. Chilcott, *A Sense of Place: Re-purposing and Impacting Historical Research Evidence through Digital Heritage and Interpretation Practice*. International Journal of Intangible Heritage, 2013, 8, 165–177.
- [25] A.M. Triesman, *Verbal cues, language, and meaning in selective attention*. American Journal of Psychology, 1964, 77, 206–219.
- [26] A.M. Triesman, J.G.A. Riley, *Is selective attention perception or selective response: A further test*. Journal of Experimental Psychology, 1969, 79, 27–34.
- [27] H.G. Hoffman, J. Prothero, M. Wells, J. Groen, *Virtual chess: the role of meaning in the sensation of presence*. International Journal of Human-Computer Interaction, 1998, 10, 251–263.
- [28] C. Cruz-Neira, *Computational Humanities: The New Challenge for VR*. IEEE Computer Graphics and Applications, 2003, 23, 10–13.
- [29] M. Ferrari, S. Ives, *Las Vegas: An Unconventional History*. Bulfinch. 2005.
- [30] J. Burbank, *Historic Photos of Las Vegas*. Turner. 2007.
- [31] L. Solanilla, *The Internet as a Tool for Communicating Life Stories: A New Challenge for Memory Institutions*. International Journal of Intangible Heritage, 2008, 3, 103–16.

- [32] H. Kean, *Personal and Public Histories: issues in the presentation of the past*. B. Graham and P. Howard (eds), The Ashgate Research Companion to Heritage and Identity, Aldershot, Ashgate, 2008, 55-69.
- [33] P. Debevec, C. Taylor, J. Malik, G. Levin, G. Borshukov, E. Yu, *Image-Based Modeling and Rendering of Architecture with Interactive Photogrammetry and View-Dependent Texture Mapping*. International Symposium on Circuits and Systems (ISCAS), Monterey, CA, May 31 – 3 June 1998.
- [34] Y. Furukawa, B. Curless, S.M. Seitz, R. Szeliski, *Reconstructing Building Interiors from Images*. ICCV 2009, Kyoto, Japan, September 27 – October 4 2009.
- [35] S.E. Chen, *QuickTime VR: an image-based approach to virtual environment navigation*. SIGGRAPH 1995, Los Angeles (CA), USA, August 6-11 1995.
- [36] E. Bourque, G. Dudek, *Automated creation of image-based virtual reality*. Sensor Fusion and Decentralized Control in Autonomous Robotic Systems. 1997.
- [37] A. Bottino, A. Martina, *The Role of Computer Games Industry and Open Source Philosophy in the Creation of Affordable Virtual Heritage Solutions*. New Trends in Technologies: Devices, Computer, Communication and Industrial Systems, 2010, 421-444.
- [38] J. Willis, *A Framework for Task-based Learning*. Longman Addison-Wesley, Harlow, UK. 1996.
- [39] F. Bellotti, R. Berta, A. DeGloria, M. Pellegrino, L. Primavera, G. Panizza, *Designing Serious Games for Cultural Heritage Purposes*. Digital Games and Learning. Continuum International Publishing Group, New York, USA, 2011, 252-276.
- [40] NUI Group Authors, *Multi-touch technologies*. 2009. Accessed December 2013. [http://nuicode.com/attachments/download/115/Multi-Touch\\_Technologies\\_v1.01.pdf](http://nuicode.com/attachments/download/115/Multi-Touch_Technologies_v1.01.pdf)
- [41] D.A. Guttentag, *Virtual Reality: Applications and Implications for Tourism*. Tourism Management, 2010, 31, 637-651.

